

CLAIMS

1. A self-attaching female fastener for attachment to a metal panel, said self-attaching female fastener comprising:

a central pilot portion having an end face and a bore extending through
5 said end face through said pilot portion;

a flange portion on at least opposed sides of said pilot portion having a generally planar panel support face generally parallel to said end face of said pilot portion; and

a groove in said panel support face of said flange portion adjacent said
10 pilot portion, said groove including an inclined inner side wall defining an outer face of said pilot portion, an inclined outer side wall and a V-shaped bottom wall, said inner side wall inclined outwardly from said bottom wall toward said flange portion and said outer side wall inclined inwardly from said bottom wall toward said pilot portion forming an opening of said groove adjacent said panel support face having a
15 width less than a width of said groove at said bottom wall, and said V-shaped bottom wall having generally equal opposed relatively inclined bottom faces defining sides of an equilateral triangle having an apex extending away from a plane of said panel support face generally equally spaced between said inner and outer side walls of said groove.

20 2. The self-attaching female fastener as defined in Claim 1, wherein said bottom faces of said V-shaped groove are inclined relative to said generally planar panel support face at an angle of between 15 and 25 degrees.

3. The self-attaching female fastener as defined in Claim 1, wherein said bore is in internally threaded and said self-attaching female fastener includes a back
25 face opposite said end face of said pilot portion having a recess surrounding said bore.

4. The self-attaching female fastener as defined in Claim 1, wherein said apex of said V-shaped bottom wall is arcuate.

5. The self-attaching female fastener as defined in Claim 1, wherein said flange portion is rectangular including said panel support face on opposed sides of said pilot portion and said groove comprises linear grooves on opposed sides of pilot portion in said panel support face, and said female fastener including a back face opposite said panel support face of said flange portion having linear grooves adapted to receive frangible connector elements aligned with said apex of said bottom wall of said V-shaped grooves.

10 6. The self-attaching female fastener as defined in Claim 1, wherein said end face of said pilot portion is spaced above said panel support face of said flange portion and said pilot portion including an outer surface spaced above said panel support face extending generally perpendicular to said end face, said inner and outer side walls of said groove inclined at an angle of between 10 and 20 degrees and said
15 opposed relatively inclined bottom faces of said V-shaped bottom wall are planar and inclined relative to said panel support face at an angle of between 10 and 15 degrees.

7. A self-attaching female fastener for attachment to a metal panel, said female fastener comprising:

a central pilot portion having an end face and a bore extending through said end face through said pilot portion;

5 a generally rectangular flange portion on opposed sides of said pilot portion having generally planar panel support faces extending generally parallel to said end face of said pilot portion; and

linear grooves on opposed sides of said pilot portion in said panel support faces of said flange portion, said grooves each having a generally planar
10 inclined inner side wall defining outer faces of said pilot portion, a generally planar inclined outer side wall and a V-shaped bottom wall, said inner side wall inclined outwardly from said bottom wall toward said outer side wall and said outer side wall inclined inwardly from said bottom wall toward said inner side wall to adjacent said panel support faces of said flange portion forming a restricted opening to said grooves
15 having a width adjacent said panel support faces less than a width of said groove adjacent said V-shaped bottom wall, and said V-shaped bottom wall including relatively inclined bottom faces having an apex extending away from said panel support faces of said flange portion.

8. The self-attaching female fastener as defined in Claim 7, wherein said
20 bottom faces of said V-shaped bottom wall are generally equal in width and said apex is generally equally spaced between said inclined inner and outer side walls of said grooves.

9. The self-attaching female fastener as defined in Claim 7, wherein said self-attaching female fastener includes a back face opposite said panel support faces of said flange portion including linear grooves adapted to receive frangible connector elements aligned with said apex of said bottom faces of said V-shaped bottom wall.

5 10. The self-attaching female fastener as defined in Claim 9, wherein said back face includes a recess surrounding said bore and said bore is internally threaded.

11. The self-attaching female fastener as defined in Claim 7, wherein said bottom faces of said V-shaped groove are inclined relative to said generally planar panel support faces at an angle of between 15 and 25 degrees.

10 12. The self-attaching female fastener as defined in Claim 7, wherein said apex of said bottom faces of said V-shaped bottom wall are arcuate.

13. The self-attaching female fastener as defined in Claim 12, wherein said apex of said bottom faces of said V-shaped groove have a radius of about 0.05 inches or less.

14. A method of attaching a self-attaching female fastener to a metal panel, said method comprising the following steps:

locating a metal panel opposite a die member, said die member including a projecting lip having an end face;

5 locating a self-attaching female fastener opposite said panel, said self-attaching female fastener including a central pilot portion having an end face and a bore through said end face through said pilot portion, a flange portion on at least opposed sides of said pilot portion having a generally planar panel support face, and a groove in said panel support face of said flange portion adjacent said pilot portion
10 aligned with said projecting lip of said die member, said groove including an inclined inner side wall adjacent said pilot portion defining an outer face of said pilot portion, an inclined outer side wall and a V-shaped bottom wall, said inner side wall inclined outwardly from said bottom wall toward said outer side wall and said outer side wall inclined inwardly from said bottom wall toward said inner side wall and said V-shaped bottom wall comprising generally equal relatively inclined bottom faces
15 having an apex extending away from said panel support face of said flange portion;

driving said end face of said projecting lip of said die member against said metal panel and substantially simultaneously driving said pilot portion of said self-attaching female fastener through an opening in said panel, said end face of said
20 projecting lip deforming a panel portion adjacent said opening into said groove in said panel support face of said flange portion and against said bottom faces of said V-shaped bottom wall of said groove, deforming said panel portion inwardly beneath said inclined inner side wall of said groove and beneath said inclined outer side wall of said groove forming a secure mechanical interlock between said panel and said
25 panel portion in said groove of said self-attaching female fastener.

15. The method of attaching a self-attaching female fastener as defined in Claim 14, wherein said apex of said bottom faces of said V-shaped bottom wall of said groove is substantially equally spaced between said inclined inner and outer side walls of said groove, said method including driving said panel portion into said apex
5 and against said bottom faces of said groove, deforming said panel portion substantially equally beneath said inclined inner side wall and against said inclined outer side wall of said groove.

16. The method of attaching a self-attaching female fastener to a metal panel as defined in Claim 14, wherein said method includes driving said end face of
10 said projecting lip of said die member against said panel portion, first deforming an edge of said panel portion at said opening into said groove and against said V-shaped bottom wall adjacent said apex of said bottom faces and continuing to drive said end face of said projecting lip against said panel portion, deforming said panel portion into said apex of said bottom faces and against said inclined inner and outer side walls of
15 said groove.

17. The method of attaching a self-attaching female fastener to a metal panel as defined in Claim 14, wherein said end face of said projecting lip of said die member includes first and second inclined end faces having a projecting apex generally aligned with said apex of said bottom faces of said V-shaped bottom wall of
20 said groove, said method including driving said apex of said end faces of said projecting lip against said panel portion, deforming said panel portion into said apex of said bottom faces of said V-shaped bottom wall and deforming said panel portion against said inclined inner and outer side walls of said groove.

18. The method of attaching a self-attaching female fastener to a metal panel as defined in Claim 14, wherein said method includes driving said end face of said pilot portion against said panel, piercing a slug from said panel, and forming said opening in said panel.

19. A method of attaching a self-attaching female fastener to a metal panel, said method comprising the following steps:

locating a metal panel opposite a die member, said die member including generally parallel projecting clinching lips each having an end face;

5 locating a self-attaching female fastener opposite said panel, said self-attaching female fastener including a central pilot portion having an end face and a bore through said end face through said pilot portion, a rectangular flange portion on opposed sides of said pilot portion having panel support faces on opposed sides of said pilot portion and generally parallel grooves in said panel support faces of said
10 flange portion adjacent said pilot portion aligned with said projecting lips of said die member, said grooves each including an inclined inner side wall defining outer faces of said pilot portion, an inclined outer side wall and a V-shaped bottom wall, said inner side wall of said grooves inclined outwardly from said bottom wall toward said outer side wall and said outer side wall inclined inwardly from said bottom wall
15 toward said inner side wall to adjacent said panel support faces forming a restricted opening to said grooves having a width adjacent said panel support faces less than a width adjacent said V-shaped bottom wall, and said V-shaped bottom wall including relatively inclined bottom faces having an apex extending away from said panel support faces of said flange portion;

20 forming an opening through said panel configured to receive said pilot portion of said self-attaching female fastener;

 driving said end faces of said projecting lips of said die member against panel portions of said metal panel adjacent said opening through said panel and substantially simultaneously driving said pilot portion of said self-attaching
25 female fastener through said opening through said panel; and

continuing to drive said end faces of said projecting lips of said die member against said panel portions, deforming panel portions into said grooves and against said relatively inclined bottom faces of said V-shaped bottom wall, deforming said panel portions inwardly against and beneath said inclined inner side wall of said
5 grooves and outwardly against and beneath said outer side wall of said grooves forming a secure mechanical interlock between said panel portions and said grooves of said self-attaching female fastener.

20. The method of attaching a self-attaching female fastener to a metal panel as defined in Claim 19, wherein said apex of said bottom faces of said V-shaped bottom wall of said grooves is substantially equally spaced between said inclined inner and outer side walls of said grooves, said method including driving said end
5 faces of said projecting lips of said die member against said panel portions against said apex of said bottom faces of said V-shaped bottom wall of said grooves, deforming said panel portions inwardly beneath said inclined inner side wall and said inclined outer side wall of said groove.

21. The method of attaching a self-attaching female fastener to a metal
10 panel as defined in Claim 19, wherein said method includes driving said end faces against said panel portions, first deforming edges of said panel portions adjacent said opening into said groove and against said V-shaped bottom wall adjacent said apex of said bottom faces and continuing to drive said end faces against said panel portions, deforming said panel portions into said apex and against said inclined inner and outer
15 side walls of said grooves.

22. The method of attaching a self-attaching female fastener to a metal panel as defined in Claim 19, wherein said end faces of said projecting lips of said die member each include first and second inclined end faces having a projecting apex generally aligned with said apex of said bottom faces of said V-shaped bottom wall of
20 said grooves, said method including driving said apex of said end faces of said projecting lips of said die member against said panel portions, deforming said panel portions into said apex of said bottom faces of said V-shaped bottom wall and deforming said panel portions against said inclined bottom faces inwardly against said inner side wall and outwardly against said outer side wall of said grooves.

23. The method of attaching a self-attaching female fastener to a metal panel as defined in Claim 22, wherein said first end face of said projecting lips is wider than said second end face, thereby aligning said apex of said end faces with said apex of said bottom faces of said V-shaped bottom wall, said method including
5 driving said first and second end faces of said projecting lips of said die member against said panel portions, deforming panel portions on opposed sides of said first and second inclined end faces against said V-shaped bottom wall of said groove.